Subterranean Biology 32: 33–42 (2019)
doi: 10.3897/subtbiol.32.37509
http://subtbiol.pensoft.net

RESEARCH ARTICLE

A peer-reviewed open-access journal
Subterranean Biology
Published by The International Society for Subterranean Biology

A new species of *Alpioniscus* (*Illyrionethes*) from the Dinaric Karst (Isopoda, Oniscidea, Trichoniscidae)

Jana Bedek[1], Sanja Gottstein [2], Stefano Taiti[3,4]

1 *Croatian Biospeleological Society, Demetrova 1, 10 000 Zagreb, Croatia* **2** *Department of Zoology, Faculty of Science, Rooseveltov trg 6, 10 000 Zagreb, Croatia* **3** *Istituto di Ricerca sugli Ecosistemi Terrestri, CNR, Via Madonna del Piano 10, 50019 Sesto Fiorentino (Florence), Italy* **4** *Museo di Storia Naturale dell'Università di Firenze, Sezione di Zoologia "La Specola", Via Romana 17, 50125 Florence, Italy*

Corresponding author: *Jana Bedek* (jana.bedek@hbsd.hr)

Academic editor: *Oana Moldovan* | Received 19 June 2019 | Accepted 6 August 2019 | Published 9 September 2019

http://zoobank.org/F8968068-8468-44EA-8332-0FB20E3EA84C

Citation: Bedek J, Gottstein S, Taiti S (2019) A new species of *Alpioniscus* (*Illyrionethes*) from the Dinaric Karst (Isopoda, Oniscidea, Trichoniscidae). Subterranean Biology 32: 33–42. https://doi.org/10.3897/subtbiol.32.37509

Abstract

In the Dinaric Karst, *Alpioniscus* (*Illyrionethes*) is the taxon with the largest number of troglobiotic species (19), one of which is new and described here: *A. busljetai* **sp. nov.**, found in two caves in the coastal area of North Dalmatia. Both caves are threatened by human activities (IUCN threats 1.1, 9.1.1).

Keywords

Adriatic coast, cave fauna, new species, terrestrial isopods, Trichoniscinae, troglobiotic

Introduction

Alpioniscus Racovitza, 1908 is the most abundant and widespread terrestrial isopod genus in caves of the Dinaric Karst. It is represented by the subgenus *Illyrionethes* Verhoeff, 1927, with a range from Trieste in Italy to Durmitor in Montenegro (Schmalfuss 2003, Horvatović 2014). This subgenus is present also with six endogean, troglobiotic and stygobiotic species in Sardinia, Italy (Taiti et al. 2018). A recent integrative taxonomic study of *Illyrionethes* species from the Dinaric Karst revealed 19 troglobiotic species, one of which remained undescribed (Bedek et al. 2017; Bedek et al. 2019; in press). They

Copyright *Jana Bedek et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

grouped into three different lineages (*strasseri*-, *heroldi*- and *magnus*-lineage), with overlapping ranges. Nine species are restricted to coastal areas with limited distribution ranges: *A. christiani* (Potočnik, 1983) from the *strasseri*-lineage; *A. magnus* (Frankenberger, 1938), *A. lossinii* Bedek, Gottstein & Taiti, 2019, *A. drazinai* Bedek, Gottstein & Taiti, 2019, and *A. mandalinae* Bedek, Gottstein & Taiti, 2019 from the *magnus*-lineage; *A. trogirensis* Buturović, 1955, *A. kratochvili* (Frankenberger, 1938), *A. haasi* (Verhoeff, 1931) and the new species described below from the *heroldi*-lineage.

Material and methods

Specimens were hand collected with tweezers, fixed and stored in 75% ethanol with glycerol or 96% ethanol. Several specimens were dissected and mounted for micropreparations in Hoyer's medium (Anderson 1954). For identifications and illustrations in the description, the entire body and the following appendages were used: antennae, antennulae, buccal pieces, male pereopods 1 and 7, genital papilla and male pleopods 1 and 2. Specimens were examined under a Zeiss Stemi 2000-C, Zeiss Primo Star and Nikon Labophot microscopes. Micropreparations were photographed using Canon EOS 40D and EOS Utility software. Drawings were made from photographs. The examined material, description, etymology and remarks are given. The following numerical characters were counted: the number of (1) antennular aesthetascs, (2) antennal flagellum articles, (3) antennal flagellum articles bearing aesthetascs, and (4) setae on the male pereopod 1 carpus. The terminology used in species description is mainly based on Vandel (1960, 1962). The locality coordinates used the WGS84 datum. The map was drawn using ArcMap 10.1 software and related Shadow Relief layer. The IUCN threats are determined according to the Classification Schemes used in IUCN Red List assessments (IUCN 2012).

Repositories:

CBSSC Croatian Biospeleological Society Collection, Zagreb, Croatia
MZUF Museo di Storia Naturale dell'Università di Firenze, Sezione di Zoologia La Specola, Florence, Italy

Taxonomy

Family Trichoniscidae Sars, 1899
Subfamily Trichoniscinae Sars, 1899
Genus *Alpioniscus* Racovitza, 1908
Subgenus *Illyrionethes* Verhoeff, 1927

***Alpioniscus* (*Illyrionethes*) *busljetai* sp. nov.**
http://zoobank.org/F48F1286-A661-4B19-AC7E-3B37FC333E53
Figs 1–6

Alpioniscus sp. – Bregović et al. 2008: 109 [partim: Markova špilja].
Alpioniscus (*Illyrionethes*) sp. 3. – Bedek et al. in press: figs 3, 5.

Material examined. Holotype: ♂ Croatia, Starigrad Paklenica, Seline, Markova špilja (cave), 44°16.79'N, 15°28.63'E, 30.IX.2008, D. Hmura leg., CBSSC IT4252. **Paratypes:** 1 ♂, 1 ♀, 1 juv., same data as holotype, CBSSC IT2407; 1 ♀, 1 juv., ibid., 5.VI.2006, H. Bilandžija leg., CBSSC IT560; 2 ♂♂, 1 ♀, ibid., 5.VI.2006, M. Pavlek leg., CBSSC IT561; 2 ♂♂, 2 ♀♀, ibid., 1.V.2010, A. Kirin leg., CBSSC IT2235; 1 ♂ juv., ibid., 1.V.2010, M. Lukić leg., CBSSC IT3975; 1 ♂ juv., ibid., 18.XII.2012, A. Komerički leg., CBSSC IT2881; 1 ♀, ibid., 18.III.2013, K. Miculinić leg., CBSSC IT3974; 1 ♂, 1 ♀, 1 juv., ibid., 20.V.2018, P. Bregović leg., MZUF 9894; 3 ♂♂, 4 ♀♀, ibid., 20.V.2018, N. Kuharić leg., CBSSC IT4250; 2 ♀♀, ibid., 20.V.2018, N. Kuharić leg., CBSSC IT4398; 2 ♀♀, ibid., 20.V.2018, I. Jaklinović leg., CBSSC IT4251; 2 ♀♀, 1 juv., ibid., 20.V.2018, M. Čuček leg., CBSSC IT4399; 2 ♂♂, 1 ♂ juv., 2 ♀♀, Croatia, Starigrad Paklenica, Špecina špajza (cave), 44°17.10'N, 15°27.46'E, 29.VI.2013, A. Komerički leg., CBSSC IT3960; 2 ♀♀, ibid., 29.VI.2013, T. Dražina leg., CBSSC IT3961; 1 ♂, 1 ♀, ibid., 29.VI.2013, T. Dražina leg., CBSSC IT3962.

Figure 1. *Alpioniscus* (*Illyrionethes*) *busljetai* sp. nov. *in situ* in Markova špilja (by courtesy of Petra Kutleša). Scale bar: 1 mm.

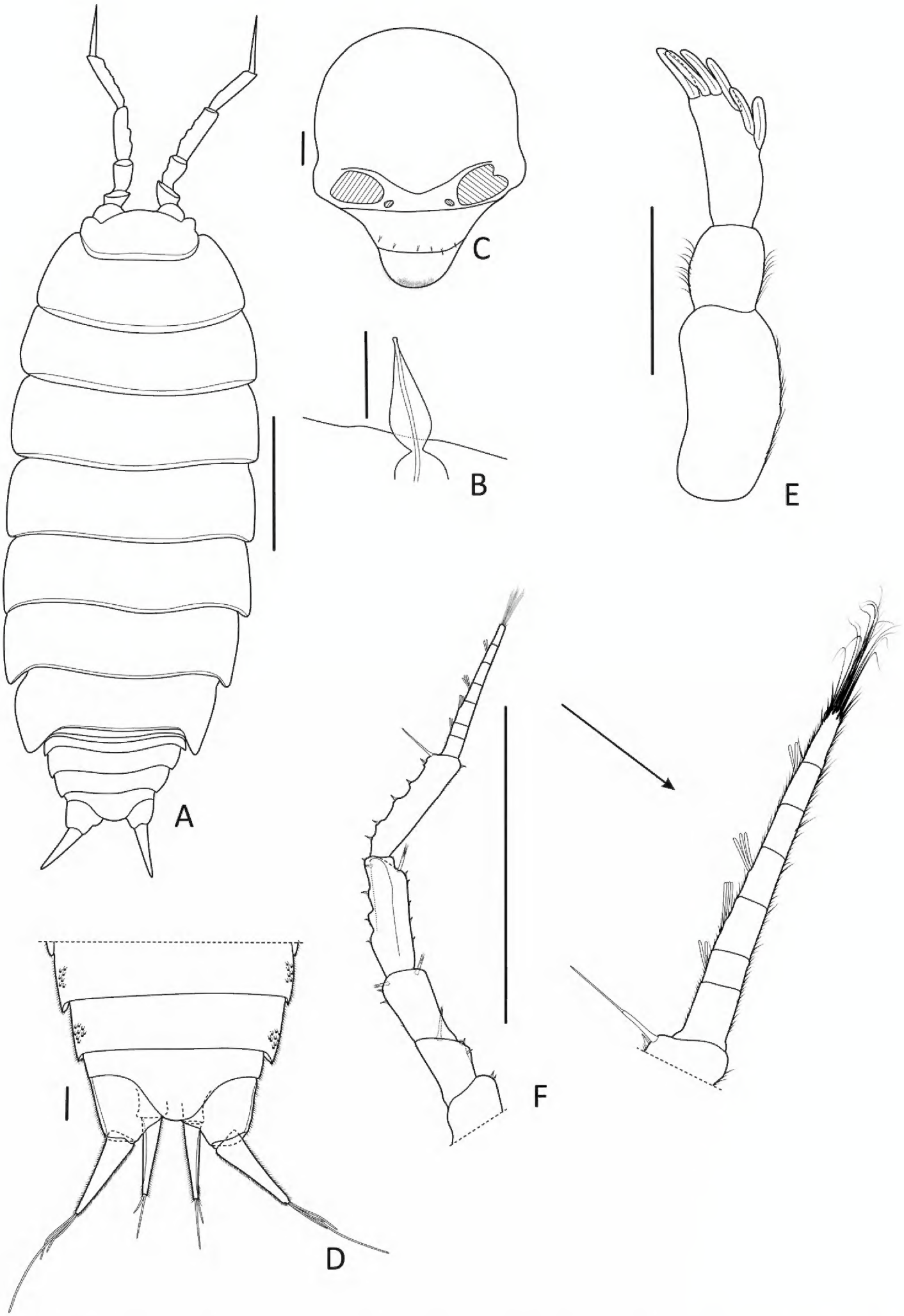

Figure 2. *Alpioniscus* (*Illyrionethes*) *busljetai* sp. nov. Paratype ♀ CBSSC IT2235 from Markova špilja **A** habitus in dorsal view. Paratype ♂ CBSSC IT2235 from Markova špilja **B** dorsal scale-seta **C** cephalon, dorsal **D** pleonites 4, 5, telson and uropods. Paratype ♂ CBSSC IT4250 from Markova špilja **E** antennula **F** antenna with enlargement of flagellum. Scale bars: 1 mm (**A, F**), 0.1 mm (**C–E**), 0.01 mm (**B**).

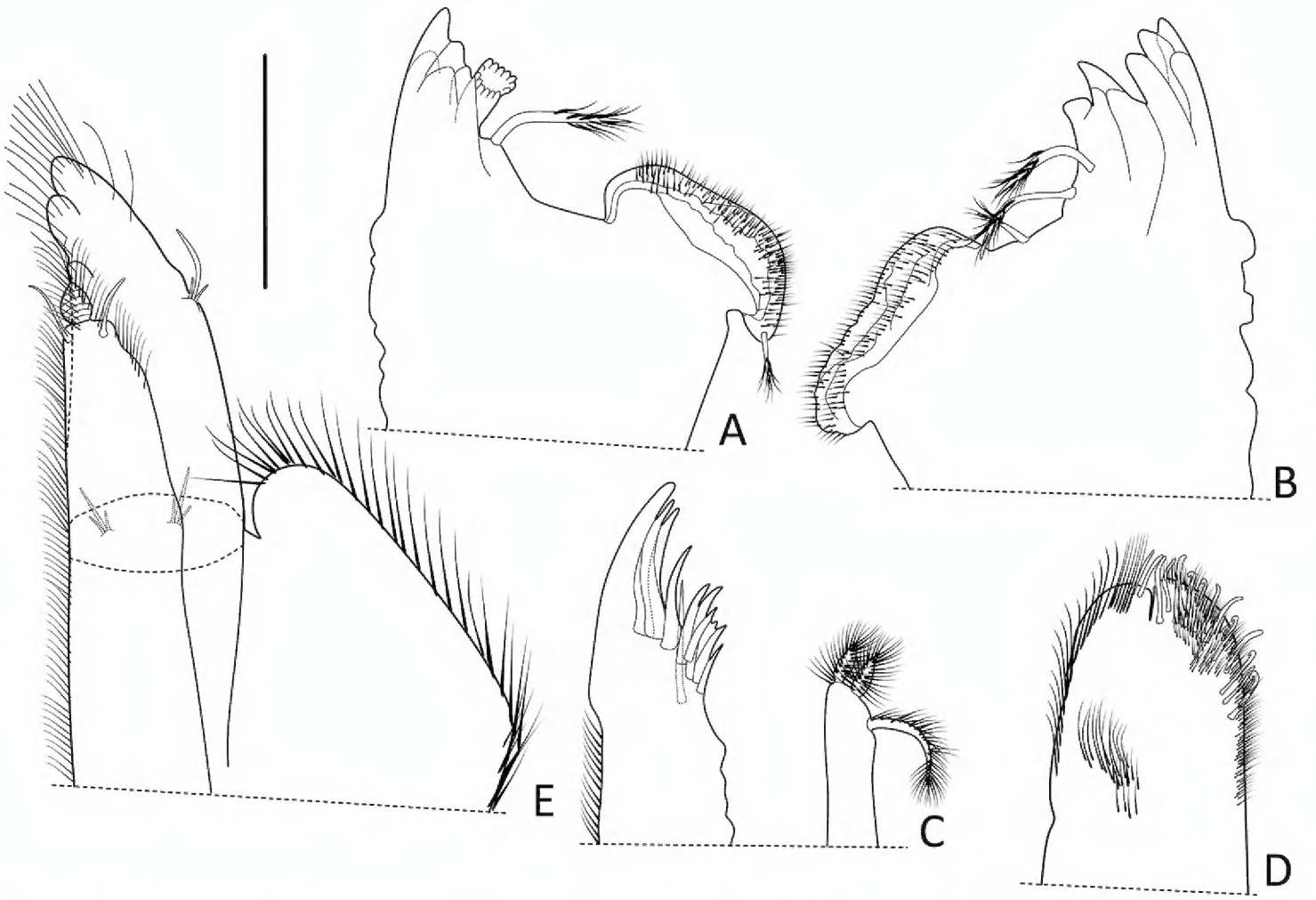

Figure 3. *Alpioniscus* (*Illyrionethes*) *busljetai* sp. nov. Paratype ♂ CBSSC IT2235 from Markova špilja **A** right mandible **B** left mandible **C** maxillula **D** maxilla **E** maxilliped. Scale bar: 0.1 mm.

Description. Maximum length: ♂, 4.4 mm; ♀, 6.0 mm. Colourless body, pereon with almost parallel sides, pleon narrower than pereon (Figs 1, 2A). Back smooth, with ridges near posterior margins of cephalon and pereonites, and some triangular scale-setae (Fig. 2B). Some gland pores on lateral margins of pleonites 4 and 5 (Fig. 2D). Eyes absent. Cephalon (Fig. 2C) with suprantennal line bent downwards; antennal lobes rounded. Posterior margin of pereonite 1 convex, of pereonites 2, 3 straight, and of pereonites 4–7 progressively more concave (Fig. 2A). Pleonites 3–5 with small posterior points visible in dorsal view (Fig. 2D). Distal part of telson with concave sides and broadly rounded apex (Fig. 2D). Antennula (Fig. 2E) of three articles, distal article flattened and bearing five to six aesthetascs. Antenna (Fig. 2F) with distal articles of peduncle granulated; flagellum of five to seven articles with one row of aesthetascs on two to four different articles, always on second and third. Mandibles (Fig. 3A, B) with one penicil in right and three in left; molar process with one penicil in right and none in left. Outer branch of maxillula (Fig. 3C) with 4+6 teeth, apically entire, and one slender stalk; inner branch with three penicils, outer and middle subequal, inner distinctly longer. Maxilla (Fig. 3D) with setose and bilobate apex, lobes subequal in width. Maxilliped (Fig. 3E) endite narrow, with large segmented apical penicil; palp distally with three rounded lobes, basal article with two small compound setae; basis with rounded outer lobe protruding posteriorly and covered with long setae on margin. Pereopods with large, bifid and setose dactylar seta (Fig. 4A). Uropod (Fig. 2D)

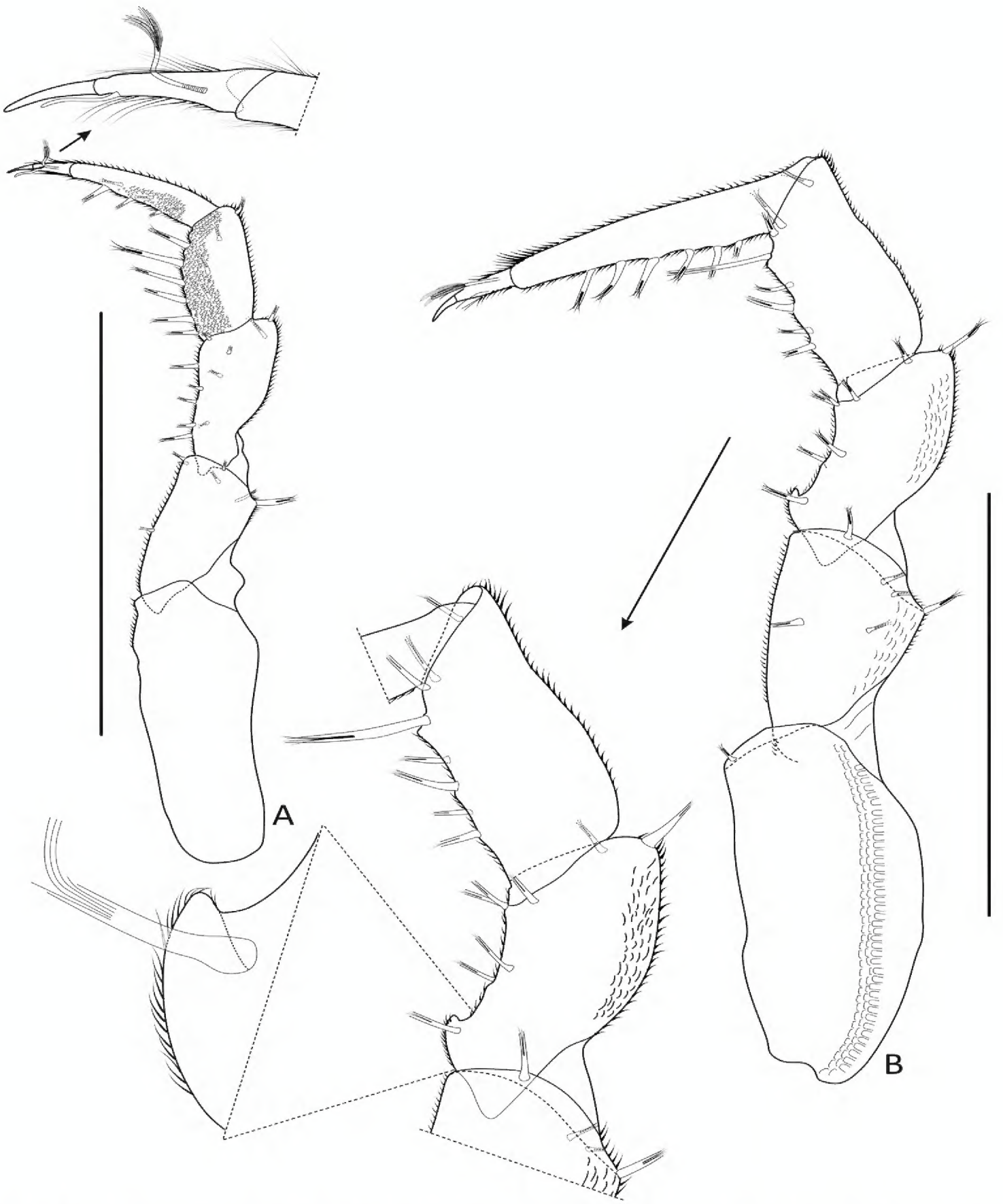

Figure 4. *Alpioniscus* (*Illyrionethes*) *busljetai* sp. nov. Paratype ♂ IT4250 from Markova špilja **A** pereopod 1 with enlargement of dactylus **B** pereopod 7 rostral view with enlargement of carpus and merus, and merus hook. Scale bars: 1 mm.

with protopod slightly grooved on outer margin; endopod distinctly shorter than exopod, proximally inserted.

Male. Pereopod 1 (Fig. 4A) carpus bearing four to six setae. Pereopod 1 and 2 with propodus and carpus bearing numerous short scales on rostral surface. Pereopods

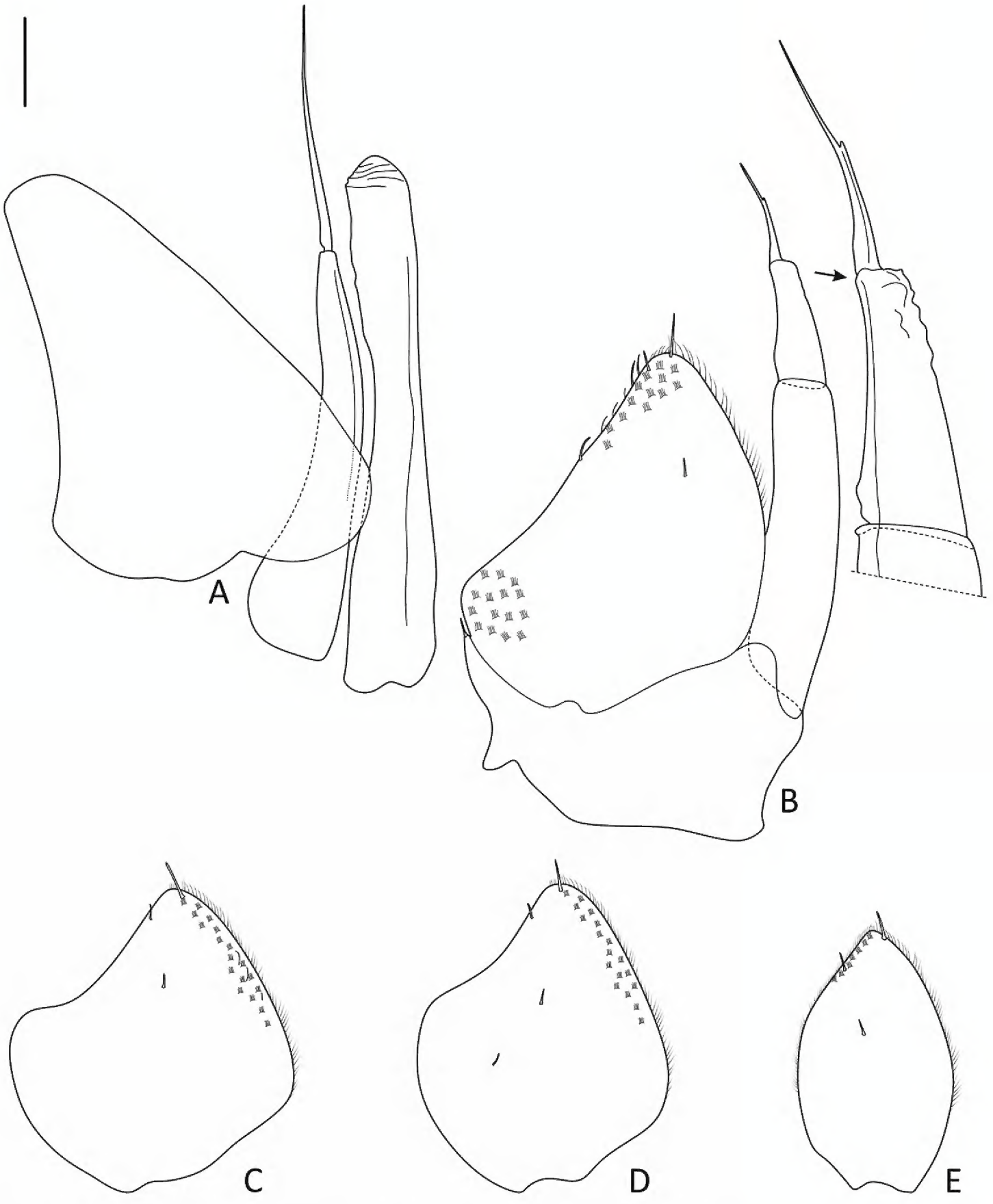

Figure 5. *Alpioniscus* (*Illyrionethes*) *busljetai* sp. nov. Paratype ♂ IT4250 from Markova špilja **A** genital papilla and pleopod 1 **B** pleopod 2 with enlargement of endopod tip. Paratype ♂ CBSSC IT2235 from Markova špilja **C** pleopod 3 exopod **D** pleopod 4 exopod **E** pleopod 5 exopod. Scale bar: 0.1 mm.

1–4 merus with sternal margin straight, pereopods 5, 6 merus with progressively more concave sternal margin and small lobe proximally. Pereopod 7 (Fig. 4B) ischium with straight sternal margin; merus with slightly concave sternal margin and small hook-shaped lobe in proximal part directed ventro-laterally and bearing one seta; carpus with

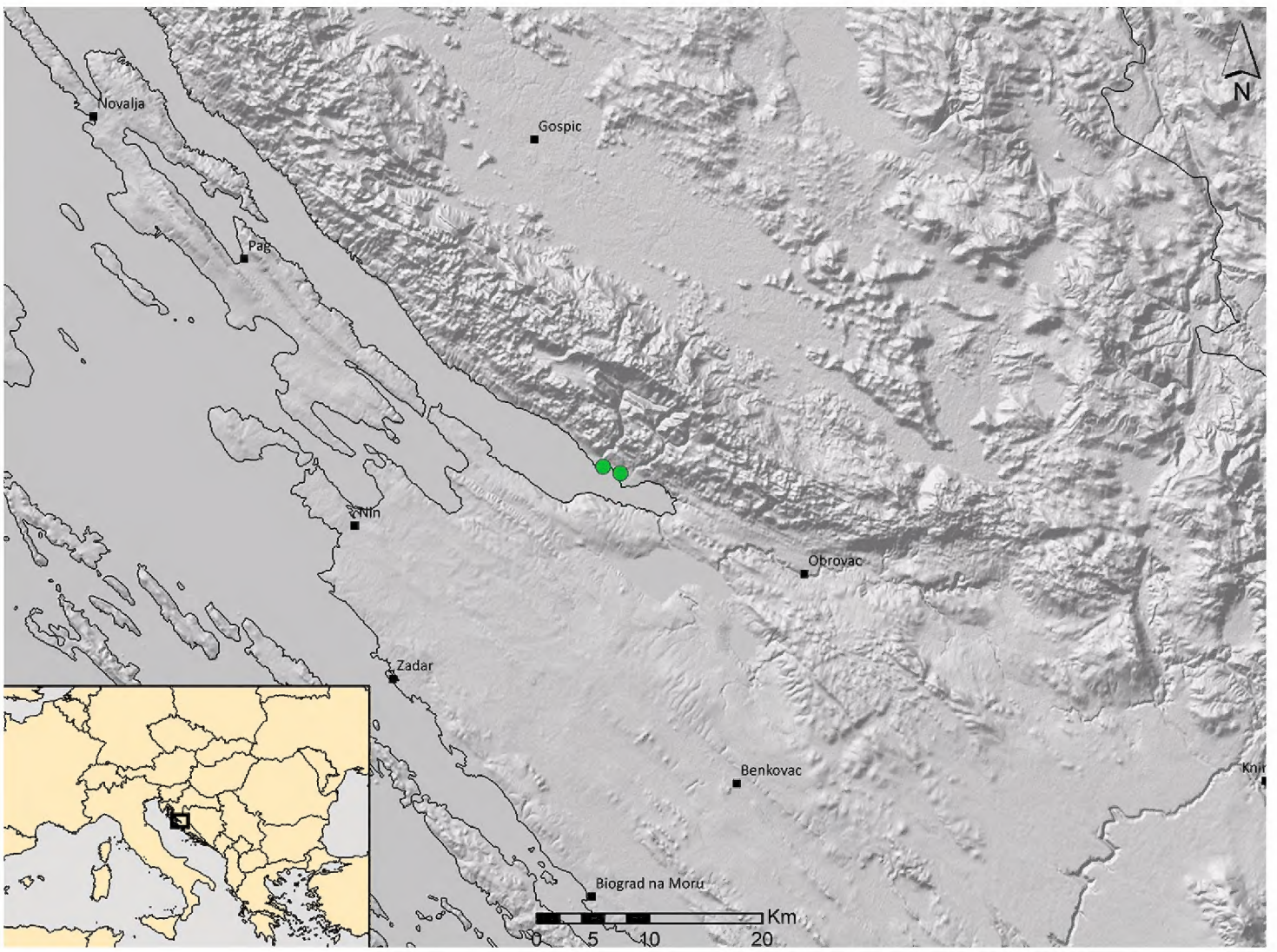

Figure 6. Distribution map of *Alpioniscus* (*Illyrionethes*) *busljetai* sp. nov.

straight sternal margin and shallow and long rounded tergal hump in proximal part. Genital papilla (Fig. 5A) with rounded apical part. Pleopod 1 (Fig. 5A) exopod with posterior apex broadly rounded, slightly concave outer margin, straight inner margin; endopod narrow with almost parallel sides, armed with long apical seta. Pleopod 2 (Fig. 5B) exopod triangular with concave outer margin; endopod of two articles, distinctly longer than exopod, posterior part narrower than anterior with strong bifid terminal seta. Pleopod 3–5 exopods as in Fig. 5C–E.

Etymology. The species is named after Dujo Bušljeta, the National park Paklenica ranger and Croatian Biospeleological Society field research guide within the Paklenica area.

Remarks. *Alpioniscus busljetai* sp. nov. differs from Dinaric *Illyrionethes* species by the shallow and long rounded tergal hump of the male pereopod 7 carpus, similar to the one present only in *A. trogirensis*. It differs from *A. trogirensis* in the shape of the male pleopod 1 exopod, with broadly rounded posterior apex and slightly concave outer margin (narrowly rounded posterior apex and sinuous outer margin in *A. trogirensis*). The shape of the male pleopod 1 exopod is similar to the one of *A. tuberculatus* (Frankenberger, 1939), from which it differs by the presence of the dorsal hump of the male pereopod 7 carpus and smooth habitus.

Discussion

Alpioniscus busljetai sp. nov. belongs to the *heroldi*-lineage according to the molecular analysis and to the slightly concave outer margin of the male pleopod 1 exopod, a character in common also with the species of the *magnus*-lineage (Bedek et al. in press).

The majority of Dinaric *Illyrionethes* species are not particularly endangered (Ozimec et al. 2009). About half species are restricted to a relatively small, usually coastal, area, and five species are known from a single or just two caves. *Alpioniscus busljetai* sp. nov. is found in only two caves in the coastal area of the Velebit Mt., North Dalmatia. Both caves are located in a rural area, with strong potential for tourism growth. Markova špilja is a small, anchialine cave, in the vicinity of houses at the end of the village Seline. Further growth of the village represents the potential risk of a negative impact on the cave or even its destruction (IUCN threat 1.1). Špecina špajza is a small cave with a cave lake, placed among houses in the village Starigrad Paklenica. The human impact on the cave is already present, by housing waste water (IUCN threat 9.1.1) and because the entrance to the cave has been completely destroyed due to construction work (IUCN threat 1.1) (Ana Komerički and Tvrtko Dražina pers. com.).

All the narrow endemics of *Alpioniscus* in the Dinaric Karst are facing or already have been threatened by human activities due to the high urbanisation of the Adriatic coast. The cave fauna inventory and taxonomic analyses are still fundamental for the conservation of the cave biodiversity in the Dinaric Karst.

Acknowledgments

The authors are grateful to all collectors (Dajana Hmura, Helena Bilandžija, Martina Pavlek, Alen Kirin, Marko Lukić, Ana Komerički, Kazimir Miculinić, Petra Bregović, Nikolina Kuharić, Ivica Jaklinović, Marija Čuček and Tvrtko Dražina) and other biospeleologists from the Croatian Biospeleological Society and Biological Students Society BIUS which helped with the fieldwork. Petra Kutleša is acknowledged for providing and Tin Rožman for editing the specimen photo *in situ*. The authors appreciate the comments and suggestions by the revievers Ivo Karaman and Ivanklin Soares Campos-Filho. Research partly supported by the National Park Paklenica.

References

Anderson LE (1954) Hoyer's Solution as a Rapid Permanent Mounting Medium for Bryophytes. The Bryologist 57: 242. https://doi.org/10.2307/3240091

Bedek J, Gottstein S, Taiti S (2019) Taxonomy of *Alpioniscus* (*Illyrionethes*): *A. magnus* and three new species from the Dinaric Karst (Isopoda: Oniscidea: Trichoniscidae). Zootaxa 4657 (3): 483–502. https://doi.org/10.11646/zootaxa.4657.3.4

Bedek J, Horvatović M, Karaman I (2017) A new troglobiotic species, *Alpioniscus* (*Illyrionethes*) *iapodicus* n. sp. (Crustacea: Oniscidea: Trichoniscidae), from Lika region, Croatia. Natura Croatica 26: 205–214. https://doi.org/10.20302/NC.2017.26.17

Bedek J, Taiti S, Bilandžija H, Ristori E, Baratti M (in press) Molecular and taxonomic analyses in troglobiotic *Alpioniscus* (*Illyrionethes*) species from the Dinaric Karst (Isopoda: Trichoniscidae). Zoological Journal of the Linnean Society. https://doi.org/10.1093/zoolinnean/zlz056

Bregović P, Crnčan P, Ćukušić A, Dražina T, Đud L, Hmura D (2008) Biospeleološka istraživanja NP Paklenica. In: Čolić L, Kapelj S (Eds) Zbornik istraživačkih radova – Nacionalni park Paklenica 2008. Udruga studenata biologije-BIUS, Zagreb, 95–117.

Buturović A (1955) Isopodes nouveaux (Isop. terrestria) de Macédonie et Dalmatie. Acta Musei Macedonici Scientiarum Naturalium 3: 145–157.

Frankenberger Z (1938) Sur les genres *Illyrionethes* Verh. et *Aegonethes*, g. n. (isopodes). Archives de Zoologie expérimentale et générale 80: 25–37.

Frankenberger Z (1939) Über von Herrn Dr. J. Kratochvil in Jugoslawien gesammelte Höhlenisopoden. II. Zoologischer Anzeiger 128: 98–106.

Horvatović M (2014) Phyletic relations within Synocheta Legrand, 1946 section (Crustacea, Isopoda, Oniscidea) of the Balkan Peninsula. PhD Thesis, University of Novi Sad, Novi Sad.

IUCN (2012) Threats classification scheme (version 3.2). https://www.iucnredlist.org/technical-documents/classification-schemes/threats-classification-scheme [June 18, 2019]

Ozimec R, Bedek J, Gottstein S, Jalžić B, Slapnik R, Štamol V, Bilandžija H, Dražina T, Kletečki E, Komerički A, Lukić M, Pavlek M (2009) Crvena knjiga špiljske faune Hrvatske. [Red book of Croatian cave dwelling fauna]. Ozimec R, Katušić L (Eds) Ministarstvo kulture. Državni zavod za zaštitu prirode, Zagreb.

Potočnik F (1983) *Alpioniscus* (*Illyrionethes*) *christiani* spec. nov., eine neue Trichoniscinae-Art (Isopoda terrestria) aus Jugoslawien. Annalen des Naturhistorischen Museums in Wien 84B: 389–395.

Racovitza E (1908) Biospéologica. IX. Isopodes terrestres (seconde série). Archives de Zoologie expérimentale et générale 9: 239–415.

Sars GO (1899) An account of the Crustacea of Norway with short descriptions and figures of all the species. Volume II. Isopoda. Bergen Museum, Bergen, 270 pp. [+pls. 1–104] https://biodiversitylibrary.org/page/32172997

Schmalfuss H (2003) World catalog of terrestrial isopods (Isopoda: Oniscidea). Stuttgarter Beiträge zur Naturkunde, Serie A, 654: 1–341.

Taiti S, Argano R, Marcia P, Scarpa F, Sanna D, Casu M (2018) The genus *Alpioniscus* Racovitza, 1908 in Sardinia: taxonomy and natural history (Isopoda, Oniscidea, Trichoniscidae). Hornung E, Taiti S, Szlavecz K (Eds) ZooKeys 801: 229–263. https://doi.org/10.3897/zookeys.801.24102

Vandel A (1960) Isopodes Terrestres (Première Partie). Faune de France 64: 1–416.

Vandel A (1962) Isopodes Terrestres (Deuxième Partie). Faune de France 66: 417–931.

Verhoeff KW (1927) *Illyrionethes* n. g. eine cavernicole Trichonisciden-Gattung. Zoologischer Anzeiger 72: 268–274.

Verhoeff KW (1931) Zwei neue *Illyrionethes*-Arten aus Dalmatien. Senckenbergiana 13: 122–134.